

SOLID-STATE MILLIMETER-WAVE POWER GENERATION AND AMPLIFICATION

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Summary of Research

September 1, 1966 - February 28, 1967

The assembly of a precision S-band test set for varactor diodes is now under way. This test set will permit an evaluation of diode parameters to an accuracy of 1 part in 10^4 . The test set consists of a dual-probe slotted line with a precision balancing circuit and a null receiver. By using two probes spaced approximately $\lambda/4$ apart and by adjusting the drive on each probe until the output is balanced, the VSWR may be read directly from the attenuation in the series with one probe. This technique obviates the problems of high dynamic range instrumentation and eliminates gain variations in the receiving apparatus. This test set will be used to characterize devices for use in high-order, high-power multipliers. Again, data reduction will be assisted by the use of a computer.

With the use of MOSFET transistors, a synchronous detector of high dynamic range has been constructed for use in some precision laboratory instrumentation. The dynamic range of this unit approaches 140 db. The output drift is of the order of a few microvolts over a period of several days.

Computer programs have been developed for the analysis of cascaded transmission-line filters and for the design of cascaded transmission-line impedance matching networks. An interesting result of this work was the discovery of an impedance matching network consisting of a one-eighth wavelength transformer and a one-quarter wavelength transformer that can be used to match any impedance to the characteristic impedance of a feed line. This permits construction of microwave circuits in which the actual input impedance is unknown, in such a way that the impedance match can always be accomplished in a previously known length of transmission line. This technique hinges on

the fact that any impedance can be transformed to a real impedance by a $1/8$ wavelength transformer whose characteristic impedance is equal to the magnitude of the load impedance.

A Master's thesis by Artice M. Davis, entitled "Characterization of a Microwave Negative Resistance Diode," was accepted by the Department of Electrical Engineering, Massachusetts Institute of Technology, in December 1966. It covers the measurement and characterization of avalanche diode oscillators at KU-band and X-band. The major conclusion of this work is that the equivalent circuit of an impatt diode in the avalanche region is similar to that of a tunnel diode over a very wide frequency range. Details may be found in the thesis.

Note on Publications

R. P. Rafuse and D. H. Steinbrecher received the "Outstanding Paper Award" for their contribution to the 1966 International Solid-State Circuits Conference.

D. H. Steinbrecher has presented a paper, entitled "Efficiency Limits for Tuned Harmonic Multipliers with Punch-through Varactors," at the International Solid-State Circuits Conference, Philadelphia, Pennsylvania, February 15-17, 1967. An abstract of this paper is appended.

To be presented at the International Solid-State Circuits Conference,
Philadelphia, Pennsylvania, February 15-17, 1967

TITLE

EFFICIENCY LIMITS FOR TUNED HARMONIC MULTIPLIERS WITH PUNCH-THROUGH VARACTORS*

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ABSTRACT

Optimum efficiency design data are presented for tuned, harmonic multipliers using punch-through varactors and with idlers at all intermediate harmonics of the drive frequency.

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